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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/787,438	02/27/2004	Tetsunori Kaji	648.42456VX2	4727

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EXAMINER

DOAN, THERESA T

ART UNIT PAPER NUMBER

2814

DATE MAILED: 07/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/787,438

Applicant(s)

KAJI ET AL

Examiner

Theresa T. Doan

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 27 February 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-4 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-4 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 February 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☒ Certified copies of the priority documents have been received in Application No. 10/365,642.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date 02/27/04.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### **DETAILED ACTION**

1. The preliminary amendment filed 02/27/04 has being acknowledged and entered. By this amendment the claims 1-4 are pending in the application.

#### ***Information Disclosure Statement***

2. The prior art documents submitted by applicant in the Information Disclosure Statement filed on 02/27/04, have all been considered and made of record (note the attached copy of form PTO-1449).

#### ***Specification***

3. The amendments to the Specification that filed on 02/27/04 are acknowledged.

#### ***Drawings***

4. Figures 10-11 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 102***

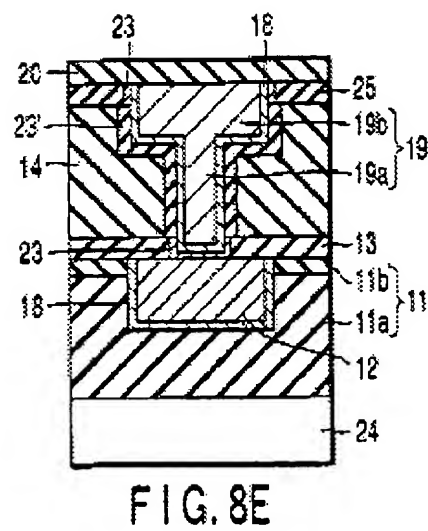
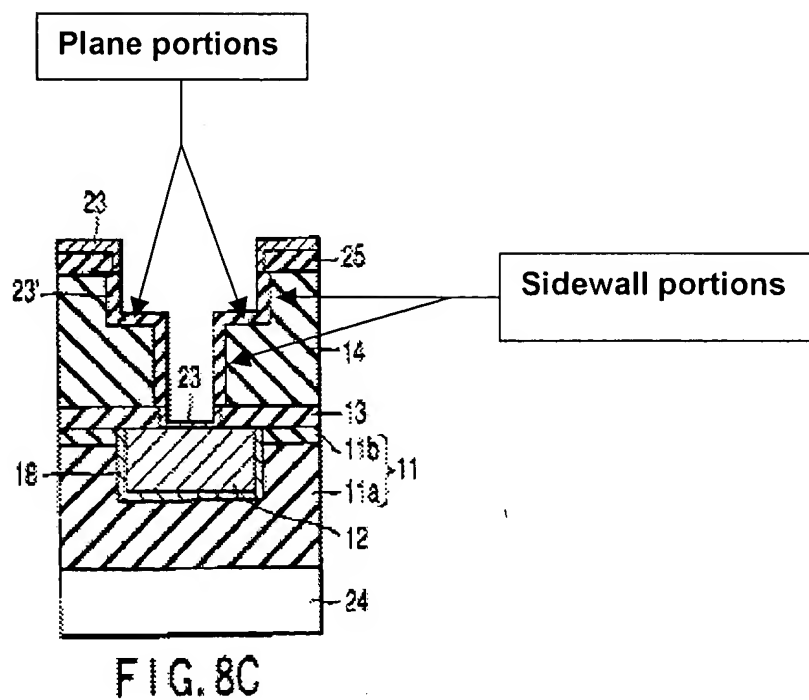
5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1-2 are rejected under 35 U.S.C. 102(e) as being anticipated by Ito et al. (U.S. Pub. 2003/0116854).

Regarding claim 1, Ito (Fig. 8E) discloses a conductive structure formed by filling copper 19 (paragraph [0060], the last 5 lines) in a plug portion 15/17 formed on an insulating film 14, the plug portion 15/17 having a metal oxide 23' (paragraph [0082]) functioning as copper barrier layer (paragraph [0084]) and formed by diffusing the metal into the insulating film 14 and reacting the metal with the insulating film 14 (paragraph [0082], lines 1-11) to reach a depth in a range of 3 nm to 50 nm (paragraph [0053] and paragraph [0077]) from the surface of side wall portions and plane portions (see Fig. 8C) defining an inner wall of the plug portion, and having copper 19 filled in the plug portion. It is noted that the conductive structure shown in Ito's Fig. 8E is a conductive damascene structure because it is formed by etching a via hole 15 and a trench 17 in an insulating layer 14 (see paragraph [0081]) (as defined by Applicant in Fig. 3 and Specification, page 19).



Regarding claim 2, Ito (Fig. 8E) discloses a conductive structure formed by filling copper 19 (paragraph [0060], the last 5 lines) in a plug portion 15/17 formed on an insulating film 14, the plug portion 15/17 having on its inner wall a two-step trench portion 15/17 comprising a large cross-section 17 and a small cross-section 15 (see Fig. 8B) via a plane portion, the plug portion 15/17 having a metal oxide 23' (paragraph [0082]) functioning as copper barrier layer (paragraph [0084]) and formed by diffusing the metal into the insulating film 14 and reacting the metal with the insulating film 14 (paragraph [0082], lines 1-11) to reach a depth in a range of 3 nm to 50 nm (paragraph [0053] and paragraph [0077]) from the surface of side wall portions and plane portions (see Fig. 8C) defining an inner wall of the plug portion, and having copper 19 filled in the plug portion. It is noted that the conductive structure shown in Ito's Fig. 8E is a conductive damascene structure because it is formed by etching a via hole 15 and a trench 17 in an insulating layer 14 (see paragraph [0081]) (as defined by Applicant in Fig. 3 and specification, page 19).

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 3-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ito et al. (U.S. Pub. 2003/0116854) in view of Raaijmakers et al. (U.S. Pat. 6,482,733).

Ito (Fig. 8E) discloses a sample having a conductive structure formed thereto by filling copper 19 (paragraph [0060], the last 5 lines) in a plug portion 15/17 formed on an insulating film 14, the plug portion 15/17 having a width with a metal oxide 23' (paragraph [0082]) functioning as copper barrier layer (paragraph [0084]) and formed by diffusing the metal into the insulating film 14 and reacting the metal with the insulating film 14 (paragraph [0082], lines 1-11) to reach a depth in a range of 3 nm to 50 nm (in claim 3) or 5 nm to 30 nm (in claim 4) (paragraph [0053] and paragraph [0077]) from the surface of side wall portions and plane portions (see Fig. 8C) defining an inner wall of the plug portion, and having copper 19 filled in the plug portion provided with the barrier layer 23'. It is note that the conductive structure shown in Ito's Fig. 8E is a conductive damascene structure because it is formed by etching a via hole 15 and a trench 17 in an insulating layer 14 (see paragraph [0081]) (as defined by Applicant in Fig. 3 and specification, page 19).

Ito does not disclose that the plug portion 15/17 having a width of 0.1  $\mu\text{m}$  or smaller. However, Raaijmakers (Fig. 9a) teaches the plug portion having the contact vias 62 that has a width of less than about 0.35  $\mu\text{m}$  and more preferably between about 0.05  $\mu\text{m}$  and 0.25  $\mu\text{m}$  (column 9, lines 27-33), the width of the plug portion can be varied depending upon the effective aspect ratio that designed for contact vias (column 9, lines 34-39).

Accordingly, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the plug portion of Ito having a width of 0.1  $\mu\text{m}$  or smaller because as taught by Raaijmakers, the width of the plug portion can

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be varied depending upon the depth of the plug portion (column 9, lines 34-39) in order to provide a desired interconnect structure having high-aspect ratio and high step coverage (column 5, lines 44-49).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Theresa T. Doan whose telephone number is (571) 272-1704. The examiner can normally be reached on Monday to Friday from 7:00AM - 4:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, WAEL FAHMY can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Theresa Doan  
July 6, 2005.